

1. On some Points in the Structure of *Hapalemur griseus*.
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A male *Hapalemur griseus* was purchased by the Society in March 1883, and its arrival at the Gardens was recorded by Mr. Sclater in the 'Proceedings' for that year (P. Z. S. 1883, p. 178). On March 17th of the present year it died and came into my hands for dissection.

So far as I am aware, there is no published description of the anatomy of the soft parts of this Lemur; and our knowledge is at present limited to its external characters, and to the dentition and osteology, which have been described by Prof. Mivart¹, who places the genus *Hapalemur*, together with *Lepilemur* and *Lemur*, in his subfamily Lemurinae.

I may commence by a few words about the species of *Hapalemur*.

The genus *Hapalemur* was originally founded by Isidore Geoffroy St. Hilaire², who distinguished two species, *H. griseus* and *H. olivaceus*. These were regarded by him as distinct not merely by reason of the different colour of the fur implied by the specific name of each, but also on account of certain differences in the form of the lower jaw, the exact nature of which is, however, not stated.

In their 'Faune de Madagascar'³ Schlegel and Pollen united these two species under the name of *H. griseus*; the differences between the two not being regarded by these authors as of specific value.

In 1870⁴ Dr. J. E. Gray briefly described a third species of *Hapalemur*, to which he gave the name of *H. simus*, distinguishing it from *H. griseus* by a number of osteological characters as well as by the colour of the fur. The differences indeed between the two species appeared to Dr. Gray to be of sufficient importance to warrant the separation of *Hapalemur simus* as a distinct subgenus, to which the name *Prolemur* is applied.

In a postscript added to this paper Dr. Gray writes that his *Hapalemur simus* appeared to be in reality the same species as that described by Pollen and Schlegel as *Hapalemur griseus*, inasmuch as their figure⁵ of the skull of this species shows the "truncated form of the nose and the wide palate" which is characteristic of *Hapalemur simus*, and is not to be found in the species known in England as *Hapalemur griseus*.

Quite recently Dr. Schlegel has written a short paper in the 'Notes from the Leyden Museum'⁶ criticizing Dr. Gray's definition of *Hapalemur simus*, and stating that the alleged differences in the form of the skull between this species and *H. griseus* have no existence, and that a careful comparison between the two species only

¹ P. Z. S. 1864, p. 611, and 1873, p. 484.

² 'Catalogue des Primates,' p. 75.

³ 'Faune de Madagascar,' 1868, t. i. p. 6.

⁴ *Loc. cit.* pl. 7. fig. 4.

⁵ P. Z. S. 1870, p. 828.

⁶ Vol. ii. p. 45.

shows certain differences in size and in the colour of the fur, *Hapalemur simus* being recognizable by the presence of a spot of a uniform pale yellowish rusty colour occupying the end of the rump and the upper part of the base of the tail, &c.¹

I have myself had the opportunity of comparing the skins as well as the skulls of *Hapalemur griseus* and *H. simus*; and the most obvious difference between the two species, which does not seem to have been noticed either by Gray or Schlegel, is a patch of spines upon the arm of the former. This is figured in the drawing (fig. 1, p. 393), and described more fully below.

With regard to the differences in the skulls of the two species, I have been able to verify Dr. Gray's statements with the exception of what he says about the lower jaw, and the description here appears to me to have been accidentally reversed. "Lower jaw weak, and narrow in front, with a short symphysis," was, I think, meant rather for *H. griseus*; while the description of the lower jaw of *Hapalemur griseus*, "Lower jaw broad and strong in front, with a long symphysis" should be applied to *Hapalemur simus*. It seems to me also that Gray was right in believing that Schlegel and Pollen's figure of the skull of *Hapalemur griseus* was in reality that of *Hapalemur simus*.

External characters.—In the Lemuroidea² generally there is some diversity in the development of the digits both of the hind and fore limbs, though in all (as contrasted with the Apes) the pollex and hallux are invariably present and well developed. A very usual character—and in this respect *Hapalemur* agrees with other Lemurs—is that the nail of the second digit of the foot is considerably elongated and claw-like.

The fleshy pads on the palmar surface of the hand and foot in *Hapalemur griseus* are very closely similar to those of *Lemur*. A large pad (Fig. 1, *a*), broader in front than behind, extends from the root of the thumb to as far back as the wrist; a second pad (*b*) lies at the base of the index; a third (*c*) between the roots of the two succeeding digits; another pad (*d*), the same size as the last but slightly smaller than that of the index, lies at the root of the fifth digit, and behind is another long pad (*e*) as large as that on the radial side of the hand, which extends as far back as the wrist.

In the foot there is a large pad on the inner side of the base of the hallux; another smaller one between this and the succeeding digit; at the root of the index is a larger pad; between the roots of the third and fourth digits is another pad about half the size of the last, and divided by a furrow into a larger outer and much smaller inner portion; at the root of the fifth digit is a small circular pad, and behind it, reaching as far as the wrist, a long narrow pad; on the radial side of the hand close to its posterior margin is a small pad.

The colour of the palmar and plantar surfaces of the hand and

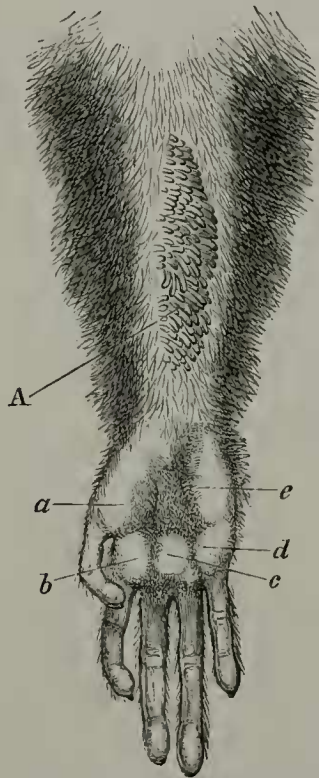
¹ *Loc. cit.* p. 49.

² Cf. Murie and Mivart's 'Anatomy of Lemuroidea,' Trans. Zool. Soc. vol. vii. p. 9, &c., for a comparison between the hands and feet of different Lemurs.

foot are black as in *Lemur* ; and in both these genera the interspaces between the pads are occupied by small isolated nodules of horny integument. In *Perodicticus* and *Nycticebus*, on the other hand, the palms of both the feet and the hands are flesh-coloured, and the interspaces between the pads are traversed by irregular creases and not separated into distinct and isolated nodules of horny matter.

On the inner side of the arm close to the wrist is an oval patch of spine-like processes, about one inch long and one third of an inch broad in the middle, which is shown in the accompanying drawing (fig. 1, A). These spines are longest in the middle portion of the

Fig. 1.

Hand of *Hapalemur griseus*.

patch, and decrease in length towards both extremities. Examined with a hand lens they present the appearance of being composed of a number of finer threads closely bound together; the extremity of the spines is blunt, and the longer ones are somewhat curved and overlap each other. The patch of integument which bears these spines is sharply marked off from the surrounding integument, and no transitional forms between the hairs of the general body-surface and these peculiar spines could be observed. The Natural-History

Museum at South Kensington contains skins of *Hapalemur griseus*, all of which with one exception (a very small, probably immature specimen) show the character that has just been described. In these specimens, however, there are no means of ascertaining the sex, and accordingly it is not possible to be quite certain whether this patch of spines is common to both sexes, or is a secondary sexual character confined to the males, though on the whole the evidence seems to point to the conclusion that it is not peculiar to the males.

So far as I am aware this structural character has not been hitherto described in this or any other Lemur, and it seems to be confined to this one species. I have examined the single specimen of *Hapalemur sinuatus* in the Natural-History Museum, and it shows no traces whatever of any such structure, nor can I find any thing like it in other Lemurs.

When the skin covering the arm was removed, an oval gland about the size and shape of an almond was seen to correspond to this patch of spines; but I could not ascertain whether there was any direct relation between them, since the duct, if any such existed, was destroyed by removing the skin. The gland was equally well developed upon both arms.

Although the specimen to which the present description relates is a male, well-developed mammary glands were found to exist. The apertures of these glands are upon the arm; and on removing the skin the glands themselves were found to be attached by membrane to the *pectoralis major*, the *biceps*, and part of the *deltoid* muscles. The position therefore, as well as the actual occurrence of these mammary glands, appears to be abnormal.

The *palate* is traversed by eight transverse ridges, of which the five anterior and the last are complete and pass from side to side without any break: the two middle ridges are interrupted in the median line. The shape of these palatal ridges, which increase in breadth progressively from before backwards, is like that of the figure 3: each half of the ridge is semicircular with the convexity directed forwards; in the middle of the palate the two semicircles meet at an angle which becomes more acute in the posterior ridges; in the anterior two ridges this angle is hardly at all marked, and the whole ridge forms a single continuous semicircle with the convexity directed forwards. The same may be said of the terminal ridge.

Each ridge passes from a given point on one side of the mouth to the corresponding point on the other: the first connects the bases of the two canines, the second passes from the interval between the two anterior premolars to the same point on the opposite side of the mouth. The third and fourth similarly connect the intervals between the succeeding premolars and molars with those of the opposite side; but the fifth ridge in the specimen examined by me is irregular, arising on the right side from the interval between the last premolar and first molar close to the ridge in front, but terminating on the left side in the interval between the first and the succeeding molar tooth, close to the ridge behind. The sixth and seventh ridges connect the intervals between the last molars of one side with the other; and the eighth

ridge, which bounds the posterior margin of the hard palate, arises a short way behind the last molar. The hard palate is distinguishable from the soft palate by its greenish colour.

The *tongue* is covered on its posterior half with a closely-set mass of large, conical, backwardly-directed papillæ; the anterior half is also covered with small papillæ, but looks almost smooth by comparison; the free tip of the tongue is slightly frayed out in a brush-like fashion. The *sublingua*, so characteristic of the Order, is well developed in *Hapalemur*, and furnished on the under surface with three folds, of which the median one is the strongest.

Beneath the sublingua is a bifid projection of the mucous membrane of the mouth, which is so largely developed that it has quite the appearance of a *third* tongue. This structure, which is also to be seen in *Perodicticus* and *Arctocebus*, appears to be the projecting termination of the ducts of the submaxillary glands.

The *stomach* is about 2 inches long, the greater portion by far belonging to the cardiac division of the organ; the entrance of the œsophagus is close to the exit of the duodenum. At the pylorus there is a complete circular valve, which separates the stomach from the duodenum, and which is considerably broader and thicker above than below. The mucous membrane lining the cavity of the stomach is raised into a few irregular longitudinal ridges.

The *small intestine* measures 2 feet 4 inches in length, while the *large intestine* is only 1 foot in length. The Peyer's patches, which in man are confined to the ileum, extend into the cæcum of *Hapalemur* and nearly as far as the termination of the colon. In the cæcum are two circular Peyer's patches, situated one in front of the other about the middle of its length, besides a number of "solitary" follicles. In the colon I counted 10 "agminated" follicles, the first placed at about an inch from the ileo-cæcal valve; there were also a great number of solitary follicles. In the small intestine there is a large Peyer's patch, about 1 inch from the ileo-cæcal aperture, and another nearly 2 inches behind this; further back still there were two others. The Peyer's patches of the small intestine are covered with villi.

So far as I am aware this is the first recorded description of Peyer's patches in the large intestine of any Lemuroid¹.

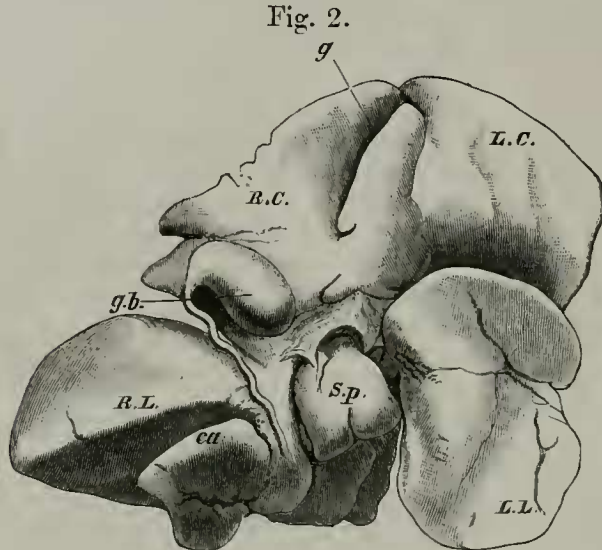
The *large intestine* is slightly wider than the small intestine; its outer surface, like that of the cæcum, is perfectly smooth and devoid of sacculations.

The *cæcum* is very simple; it is an oval sac hardly perceptibly narrower at its blind extremity; the surface is quite smooth, without any sacculations. The entrance of the ileum is guarded by a circular valve; about an inch from the ileo-cæcal aperture the cæcum passes gradually into the colon. The total length measured from the exit of

¹ Dr. G. E. Dobson, F.R.S., has discovered and recorded the presence of Peyer's patches in the rectum of *Myogale* and other species of Moles (Monogr. Insectivora, Pt. ii. p. 172, pl. xxii. fig. 5); and the same author informs me that he is about to publish in the next number of the 'Journal of Anatomy and Physiology' a description of these structures in the cæcum and colon of several Insectivora and Rodentia.

the colon to the blind extremity was about $3\frac{1}{4}$ inches, the breadth nearly $1\frac{1}{2}$ inch. The small cæcum of this Lemur recalls that of *Arctocebus*¹, and differs widely from the long tapering cæcum of *Lemur* and the Indrisinæ.

Liver.—The liver of *Hapalemur griseus* differs somewhat in detail from that of other Lemurs; the left lateral lobe (fig. 2, *L.L.*) in most Lemurs appears to be the larger of the four principal lobes; in *Hapalemur griseus* it is about the same size as the rest, which are themselves subequal; the two lateral (*L.L.*, *R.L.*) lobes are separated by a deep sulcus from the two central lobes (*L.C.*, *R.C.*); the



Liver of Hapalemur griseus.

umbilical fissure (*g*) extends only about halfway from the free to the attached border of the liver, and the right and left central lobes are almost fused into a single lobe. The Spigelian lobe (*S.p.*) is large and almost quadrangular in shape; the caudate lobe (*ca*) is well developed, and free for three fourths of its extent from the right lateral.

Viewed from the upper (diaphragmatic) surface the umbilical fissure appears as a notch barely half an inch in length; the cystic notch is conspicuous, and partially separates off a cystic lobe which is about one third of the size of the right central. The gall-bladder (*g.b.*) is large and lies in the cystic fissure; as in *Lemur* the cystic duct arises from that end of the gall-bladder which is turned towards the free edge of the liver; the fundus of the gall-bladder lies towards the attached border of the liver, the normal position of the organ being therefore reversed; the cystic duct is much contorted at its commencement.

This curious position of the gall-bladder is stated by Prof. Flower²

¹ Huxley, P. Z. S. 1864, p. 29 (fig. 9).

² "Lectures on Comparative Anatomy of the Organs of Digestion of the Mammalia," Med. Times and Gazette, 1872.

to be "characteristic of all the species of the genus *Lemur* which have been examined, as well as *Microcebus*." It does not, however, exist in all the species of the genus *Lemur*: I have a sketch made by the late Mr. Forbes of the liver of *Lemur mayottensis* in which the extremely elongated gall-bladder has the normal characters, the fundus being turned *away* from the attached surface of the liver. I have (for my own satisfaction) examined the liver of this animal, and can entirely confirm the accuracy of Mr. Forbes's observation.

The *spleen* is very similar in shape to that of the Aye-Aye; it is trihedral in form, the two portions of which it is composed being inclined at right angles; they are subequal in size, the larger measuring $1\frac{1}{4}$ inch in length.

Respiratory System.—The thyroid cartilage of the larynx is keeled on its anterior surface; at about the middle this keel is interrupted, and at this spot is a circular perforation which communicates with the interior of the larynx.

In the Potto and other Lemurs the thyroid cartilage is similarly keeled, but there is no perforation.

The *lungs* consist of three lobes on the left side and two on the right side; of these the lower larger lobe is partially subdivided into two; there is a small unpaired median lobe.

The *aorta*, as in many other Lemurs, gives off a right innominate artery, from which both carotids and the right subclavian take their origin, while the left subclavian arises separately from the aortic trunk.

The *chief arteries* of the limbs form retia mirabilia.

The *kidneys* present no differences from those of other Lemurs; the right is situated rather nearer to the diaphragm than the left; each kidney has a single papilla.

The *supra-renal bodies* are long and oval, and situated in front of and to the inside of the kidneys.

Generative Organs.—The generative organs closely resemble those of *Lemur*.

There are two large vesiculæ seminales, which lie close together behind the bladder; the upper extremity of each is bent inwards and downwards, and its cavity is partially separated off by a strong fold; the internal surface of the vesiculæ seminales has a reticulated appearance, the lining membrane being raised into numerous folds which anastomose with each other; below the vesiculæ seminales are the prostates, which are compact glands sessile upon the wall of the urethra, divided into three pairs of more or less separate glands by deep furrows upon the outer surface.

There are two large oval Cowper's glands situated further down, and opening into the urogenital canal about $\frac{3}{4}$ inch below the aperture of the prostates: these glands are greenish in colour like the rectum, to which they are closely attached by membrane; each measures rather more than $\frac{1}{2}$ an inch in length.

On slitting open the urogenital canal, an oval eminence is to be seen on the ventral surface; the posterior extremity of this colliculus seminalis is continued for some way down as a delicate fold, differing

in appearance from the surrounding mucous membrane of the urogenital canal. On either side of the colliculus seminalis and somewhat beneath is a comparatively large oval aperture, which appears to be single, and communicates with the vas deferens and vesicula seminalis of its own side. By passing a fine bristle down the vas deferens from above, it was ascertained that the latter in reality is distinct from the duct of the vesicula seminalis, and runs along its inner wall as a fine tube, the external orifice being placed to the inside of that of the vesicula seminalis and only separated from it by the thickness of its own wall.

In the majority of Lemurs the vas deferens opens separately from the vesicula seminalis and to the inside of it. In *Lemur catta* the orifices of both are situated on the upper surface of the colliculus seminalis; the vas deferens opens on to a small tongue-shaped process, which projects into the inner side of the crescentic aperture of the vesicula seminalis which nearly surrounds it. In *Loris gracilis*, *Nycticebus tardigradus*, and *Perodicticus* the orifices of the vasa deferentia and vesiculæ seminales, although very close together, open separately. Prof. Huxley states of *Arctocebus*:—"The vasa deferentia terminate in the urethra by two apertures placed close together, upon the end, or rather the under surface, of a papilla-like colliculus seminalis, which is slightly bifid at its extremity. At first I took the notch which causes this appearance for the mouth of an uterus masculinus, which I imagined might lie on the elevated ridge which extends between the apertures of the vasa deferentia and those of the ureters; but careful examination did not reveal the existence of any such structure. Two longitudinal folds of mucous membrane, along which the apertures of the prostatic ducts are situated, extend from the colliculus and form the lateral boundaries of a wide fossa, which it overhangs. This fossa receives at its upper and back part the ducts of two large oval sacs, which are perfectly distinct from one another, though their inner walls are united for some distance. The walls of these sacs are raised into oblique folds, and they lie at the back of the neck of the bladder behind the vasa deferentia, and occupy the place of the vesiculæ seminales. As they do not communicate directly with the vasa deferentia, however, I am doubtful whether they ought to be considered as representing the vesiculæ seminales, or as a large uterus masculinus."

In *Avahis laniger*, Milne-Edwards figures and describes the vesiculæ seminales as opening a long way behind the vasa deferentia; while in *Propithecus* the same author states that the vesicula seminalis opens, together with the vas deferens of its own side, by a common aperture.

There is therefore a considerable difference in different Lemurs between the relative positions of the apertures of the vesiculæ seminales and vasa deferentia. *Avahis laniger* is at one extreme of the series and *Arctocebus* at the other; in this latter genus the disappearance of the posterior portion of the colliculus seminalis has caused the apertures of the vesiculæ seminales to unite *below* the apertures of the vasa deferentia. In all other species that I have

